

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

Claims 1-14 (Canceled)

15. (Currently amended) An apparatus adapted to etch a polysilicon hard mask from a semiconductor substrate during manufacture of ~~for use in manufacturing~~ a semiconductor device, comprising:

a reaction chamber comprising a casing, and a spin chuck having a single horizontal surface and being disposed at a bottom portion of ~~within~~ said casing, said spin chuck being configured to support [[a]] the semiconductor substrate and being further configured to rotate the rotatable, whereby a semiconductor substrate supported thereon can be rotated;

a gas supply unit ~~connected to said reaction chamber, said gas supply unit supplying~~ a process gas adapted to etch the hard mask from the semiconductor substrate into the reaction chamber ~~with a process gas for removing unnecessary material from a semiconductor substrate mounted to the spin chuck in the reaction chamber;~~

a gas injection unit connected to ~~connecting~~ said gas supply unit and disposed on a sidewall of ~~to~~ said reaction chamber, said gas injection unit having at least one gas injection opening, each said at least one gas injection opening being oriented such that the gas injection unit injects the process gas, as supplied by the gas supply unit, into the reaction chamber in a structurally unimpeded, horizontal direction substantially parallel to the major upper surface of [[a]] the semiconductor substrate mounted [[to]] on the horizontal surface of the spin chuck ~~in the reaction chamber, and~~

an exhaust unit connected to said reaction chamber so as to exhaust gases from the reaction chamber.

16. (Original) The apparatus of claim 15, wherein said gas supply unit comprises a source of a fluorine-containing gaseous compound.

17. (Original) The apparatus of claim 16, wherein the compound is a gas selected from the group consisting of ClF, ClF₃, BrF, BrF₃, BrF₅, IF, IF₃, IF₅ and XeF₂.

18. (Original) The apparatus of claim 16, wherein said gas supply unit further comprises a source of a carrier gas.

19. (Currently amended) The apparatus of claim 15, wherein said gas injection unit ~~is disposed on an inner side wall of said casing of the reaction chamber, and~~ comprises a shower head having a plurality of small gas injection openings through which the process gas is horizontally injected ~~flows into the reaction chamber across the major upper surface of the semiconductor substrate mounted on the horizontal surface of the spin chuck, in a horizontal direction above said spin~~ chuck.

20. (Original) The apparatus of claim 15, and further comprising a puff valve connected in-line between said gas supply unit and said reaction chamber, said puff valve being operative to supply the process gas flowing from the gas supply unit into the reaction chamber as a series of pulses of a predetermined period.

21. (New) The apparatus of claim 15, wherein the exhaust unit comprises:
an exhaust pipe connected to the sidewall of said reaction chamber horizontally opposite the gas injection unit;
an exhaust pump having an input connected to the exhaust pipe and an output, the exhaust pump being configured to evacuate the process gas from said reaction chamber; and,
a scrubber connected to the output of the exhaust pump.

22. (New) An apparatus adapted to etch a polysilicon hard mask from a semiconductor substrate during manufacture of a semiconductor device, comprising:
a reaction chamber comprising a casing, the casing being formed by a top and a bottom surface connected by sidewalls;

a spin chuck fixedly seated near the bottom surface of the casing and connected to a rotating motor through the bottom surface of the casing, the spin chuck having a horizontal surface adapted to support a single semiconductor substrate;

a gas supply unit adapted to supply a process gas into the reaction chamber, the process gas being adapted to etch the hard mask from the single semiconductor substrate;

a gas injection unit connected to the gas supply unit and disposed on a sidewall of the reaction chamber, the gas injection unit comprising a showerhead having multiple, small gas injection openings, wherein the showerhead is oriented such that the process gas is horizontally injected across and in parallel with a major upper surface of the single semiconductor substrate; and

an exhaust unit connected to another sidewall of the reaction chamber horizontally opposite the gas injection unit and adapted to exhaust the process gas from the reaction chamber.

23. (New) The apparatus of claim 22, wherein the gas supply unit comprises an etching gas supply source and a carrier gas supply source respectively connected to a mix reservoir through a shut-off valve and a mass flow controller;

a puff valve and a pressure gage connected between the mix reservoir and the gas injection unit, wherein the puff valve, the pressure gage and the gas injection unit are adapted in combination to supply a pulsed flow of process gas horizontally across and in parallel with the major upper surface of the single semiconductor substrate.

24. (New) The apparatus of claim 23, wherein the etching gas supply source provides at least one etching gas selected from the group consisting of ClF, ClF₃, BrF, BrF₃, BrF₅, IF, IF₃, IF₅ and XeF₂.

25. (New) The apparatus of claim 24, wherein the exhaust unit comprises:
an exhaust pipe connected to the sidewall of said reaction chamber horizontally opposite the gas injection unit;

an exhaust pump having an input connected to the exhaust pipe and an output, the exhaust pump being configured to evacuate the process gas from said reaction chamber; and,

a scrubber connected to the output of the exhaust pump and adapted to absorb the etching gas.